

24. The process according to claim 5 wherein the solid sorbent is selected from the group consisting of activated carbons, activated bauxite, activated clay, activated coke, alumina, and silica gel.

5 25. The process according to claim 5 wherein the fuel exhibits a suitable flash point of at least 49° C.

REMARKS

10 This amendment is respectfully submitted to place subject Application in condition for allowance. The Specification has been amended to correct typographical errors, and improve grammar and syntax. In particular, at page 5, line 4, the term "efficent" has been replaced with --efficient--. At page 5, line 21 the term "fractrions" has been replaced with -- fractions--. At page 24, line 15 16, the term "(37,248A)" has been replaced with --09/779,283--. At page 24, line 17, the term "(37,248B)" has been replaced with --09/779,286--. At page 26, line 6, the term "oxidation" has been replaced with --hydrogenation--. At page 26, extraneous material has been deleted from lines 12 to 16. Claims 13 to 17, inclusive, 20 have been canceled without prejudice, Claims 1, 2, 5 and 9 have been amended, and new Claims 18 to 25 have been inserted.

25 In Claim 1 the expression "high-boiling hydrogenation feedstock" has amended to read as follows: "hydrotreated, petroleum distillate feedstock", and to be consistent therewith, the term "high-boiling" has been replaced with 'hydrotreated'.

Support for this amendment is found in the Specification, for example, at page 13, line 32 to page 14, line 1.

In Claim 2 the expression "catalysts are the same or different and"" has been replaced with "catalyst" to be consistent with Claim 1.

30 In Claim 5 the expression "treating at least a portion of the recovered liquid with a solid sorbent, an ion exchange resin, and/or

a suitable immiscible liquid containing a solvent or a soluble basic chemical compound, to obtain a product having a sulfur content less than about 15 ppm” has amended to read as follows:

5 treating at least a portion of the recovered liquid with a solid sorbent for a time sufficient to reduce the sulfur content of the liquid phase and thereby obtain a product having a sulfur content less than about 15 ppm : and

10 blending at least portions of the low-boiling blending component and the treated product to form fuel for use in internal combustion engines, which fuel exhibits a suitable flash point of at least 38° C. as measure by ASTM D93, and contains less than 15 ppm sulfur.

Support for this amendment is found in the Specification, for example, at page 16, lines 19 to 21, and in canceled Claim 14.

15 In Claim 9 the expression “recovering a high-boiling liquid having a sulfur content less than about 15 ppm.” has been replaced with the following:

20 recovering a liquid comprising a mixture of hydrocarbons and other organic compounds, and having a sulfur and/or nitrogen content less than the high-boiling feedstock;

25 treating at least a portion of the recovered liquid with a solid sorbent an ion exchange resin, and/or a suitable immiscible liquid containing a solvent or a soluble basic chemical compound for a time sufficient to reduce the sulfur content of the liquid phase and obtain a product having a sulfur content less than about 10 ppm : and

30 blending at least portions of the low-boiling blending component and the treated product to form fuel for use in internal combustion engines, which fuel exhibits a suitable flash point of at least 38° C. as measure by ASTM D93, and contains less than 15 ppm sulfur.

Support for this amendment is found in the Application, for example, canceled Claims 13 and 16.

New Claim 18 recites the expression "an ion exchange resin, and/or a suitable immiscible liquid containing a solvent or a soluble basic chemical compound" which was deleted from Claim 5. In particular Claims 18 is directed to a process for the production of fuel,
5 having a sulfur content less than about 15 ppm, for use in compression ignition internal combustion engines, which process comprises:

hydrotreating a petroleum distillate consisting essentially of material boiling between about 50° C. and about 425° C. and having a sulfur content in a range from about 0.1 percent by weight to about
10 0.9 percent by weight of elemental sulfur and a total nitrogen content in a range from about 5 ppm to about 900 ppm, by a process which includes reacting the petroleum distillate with a source of hydrogen at hydrogenation conditions in the presence of a hydrogenation catalyst to assist by hydrogenation removal of sulfur and/or nitrogen from the
15 hydrotreated petroleum distillate, thereby producing a hydrotreated petroleum distillate having a sulfur content less than about 500 ppm;

fractionating the hydrotreated petroleum distillate by distillation to provide at least one low-boiling blending component consisting of a sulfur-lean, mono-aromatic-rich fraction having a sulfur content less
20 than about 15 ppm, and a high-boiling feedstock consisting of a sulfur-rich, mono-aromatic-lean fraction containing the balance of the sulfur;

contacting the high-boiling feedstock with a gaseous source of dihydrogen at hydrogenation conditions in the presence of a hydrogenation catalyst which exhibits a capability to enhance the
25 incorporation of hydrogen into one or more of the sulfur-containing and/or nitrogen-containing organic compounds and under conditions suitable for hydrogenation of one or more of the sulfur-containing and/or nitrogen-containing organic compounds;

recovering a liquid comprising a mixture of hydrocarbons and
30 other organic compounds, and having a sulfur and/or nitrogen content less than the high-boiling feedstock;

treating at least a portion of the recovered liquid with an ion exchange resin and/or a suitable immiscible liquid containing a solvent or a soluble basic chemical compound, to obtain a treated
35 product having a sulfur content less than about 15 ppm; and

blending at least portions of the low-boiling blending component and the treated product to form a fuel for use in compression ignition internal combustion engines, and wherein the fuel exhibits a suitable flash point of at least 38° C. as measure by
5 ASTM D93, and contains less than 15 ppm sulfur.

Support for this amendment is found in the Specification, for example, at page 16, lines 19 to 21, Claim 5 as filed, and in canceled Claim 14.

Claim 19 recites the process according to claim 18 wherein
10 the immiscible liquid comprises an aqueous solvent containing an alkali metal hydroxide selected from the group consisting of sodium, potassium, barium, calcium and magnesium hydroxide. Support for this amendment is found in the Specification, for example, at page 17, lines 5 to 8.

15 Claim 20 recites the process according to claim 19 wherein the fuel exhibits a suitable flash point of at least 49° C. Support for this amendment is found in the Specification, for example, at page 13, lines 8 to 5, and in canceled Claim 15.

20 Claim 21 recited the process according to claim 18 wherein the hydrogenation catalysts are the same or different and comprises at least one active metal, selected from the group consisting of the *d*-transition elements, each incorporated onto an inert support in an amount of from about 0.1 percent to about 20
25 percent by weight of the total catalyst. Support for this amendment is found in canceled Claim 2.

Claim 22 recites the process according to claim 18 wherein the hydrogenation catalyst comprises one or more metals selected from the group consisting of cobalt, nickel, molybdenum and
30 tungsten. Support for this amendment is found in canceled Claim 3.

Claim 23 recites the process according to claim 9 wherein the fuel exhibits a suitable flash point of at least 49° C. Support for this amendment is found in the Specification, for example, at page 13, lines 8 to 5, and in canceled Claim 17.

5 Claim 24 recites the process according to claim 5 wherein the solid sorbent is selected from the group consisting of activated carbons, activated bauxite, activated clay, activated coke, alumina, and silica gel. Support for this amendment is found in the Specification, for example, at page 16, lines 18 to 19.

10 Claim 25 recites the process according to claim 5 wherein the fuel exhibits a suitable flash point of at least 49° C. Support for this amendment is found in the Specification, for example, at page 13, lines 8 to 5, and in canceled Claim 15.

15 In view of the amendments submitted herein, it is the position of Applicants that the instant Application is in condition for allowance.

Claim Rejections - 35 U.S.C. § 112

20 In an Office Action mailed June 17, 2002, Claims 2, 12, 15, and 17 were rejected under 35 U.S.C. § 112 second paragraph. Applicants respectfully traverse these rejections.

25 Claims 15 and 17 have been canceled with out prejudice. Claim 2 has been amended to be consistent with Claim 1, and Claim 9 has been amended to recite the proper antecedent basis for the expression "the treating" in Claim 12.

In view of the amendments submitted above, it is the position of Applicants that instant Claims 1 to 12, inclusive, and 18 to 25, inclusive, meet all requirements of 35 U.S.C. § 112.

103 Rejections

In the Office Action mailed June 17, 2002, Claims 1-4, 9-11, 16, and 17 were rejected under 35 U.S.C. § 103 (a) as being unpatentable over U.S. Patent No 6,217,748 in the name of Shigeto Hatanaka, Osamu Sadakane, and Hideshi Iki and assigned to Nippon Mitsubishi Oil Corp. (JP), (Hatanaka et al.). Applicants respectfully traverse these rejections.

Additionally, in the Office Action mailed June 17, 2002, Claims 5-8 and 12-15 were rejected under 35 U.S.C. § 103 (a) as being unpatentable over U.S. Patent No 6,217,748 in the name of Shigeto Hatanaka, Osamu Sadakane, and Hideshi Iki and assigned to Nippon Mitsubishi Oil Corp. (JP), (Hatanaka et al.) in view of U.S. Patent No 5,454,933 in the name of David W. Savage, Bal K. Kaul, Gerald D. Dupre, Joseph T. O'Bara, William E. Wales, and Teh C. Ho and assigned to Exxon Research and Engineering Company (Savage et al.). Applicants respectfully traverse these rejections.

The Hatanaka et al. U.S. patent claims foreign application priority based upon JP 2001098565 A, which was published April 18, 2000.

An affidavit under 37 CFR. § 1.131 of prior invention by Dr. George A. Huff Jr. on the 19th day of September 2002, identified as Paper No. 6, is hereby presented to further the prosecution of subject Application. In particular, the affidavit of Dr. Huff is a showing of facts which establish that reduction to practice of Applicants' invention, as described and claimed in subject application, was completed in the United States, prior to April 2000.

Applicants respectfully request Primary Examiner Griffin to withdraw rejections under 35 U.S.C. § 103 (a) which rely upon the Hatanaka et al. reference alone or in combination with the Savage et al. reference of record.

5 Base on the amendments submitted herein, Applicants urge that Claims 1 to 12, inclusive, and 18 to 25, inclusive, all claims now presented, are in condition for allowance. Applicants respectfully request Primary Examiner Griffin to pass subject application for allowance.

Do not hesitate to contact Frederick S. Jerome whose telephone number is (630) 832-7974 (FAX (630) 832-7976) if additional assistance is needed regarding this paper or earlier papers for Applicants.

10 Applicants and their undersigned Attorney appreciate the attention and further consideration of this matter by Examiner Griffin.

Respectfully submitted,

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Version of Amended Specification with
Markings to Show Changes Made

At page 5, kindly amend, lines 1 to 11, to read as follows:

Conventional hydrodesulfurization (HDS) catalysts can be used
5 to remove a major portion of the sulfur from petroleum distillates
for the blending of refinery transportation fuels, but they are not
[efficient] efficient for removing sulfur from compounds where the
sulfur atom is sterically hindered as in multi-ring aromatic sulfur
compounds. This is especially true where the sulfur heteroatom is
10 doubly hindered (e.g., 4,6-dimethyldibenzothiophene). Using
conventional hydrodesulfurization catalysts at high temperatures
would cause yield loss, faster catalyst coking, and product quality
deterioration (e.g., color). Using high pressure requires a large
capital outlay.

15 At page 5, kindly amend, lines 17 to 34, to read as follows:

The art is replete with processes said to remove sulfur from
distillate feedstocks and products. One known method involves the
oxidation of petroleum fractions containing at least a major amount
of material boiling above a very high-boiling hydrocarbon materials
20 (petroleum [fractrions] fractions containing at least a major amount
of material boiling above about 550° F.) followed by treating the
effluent containing the oxidized compounds at elevated
temperatures to form hydrogen sulfide (500° F. to 1350° F.) and/or
hydroprocessing to reduce the sulfur content of the hydrocarbon
25 material. See, for example, U.S. Patent Number 3,847,798 in the
name of Jin Sun Yoo and U.S. Patent Number 5,288,390 in the name
of Vincent A. Durante. Such methods have proven to be of only
limited utility since only a rather low degree of desulfurization is
achieved. In addition, substantial loss of valuable products may
30 result due to cracking and/or coke formation during the practice of
these methods. Therefore, it would be advantageous to develop a

process which gives an increased degree of desulfurization while decreasing cracking or coke formation.

At page 24, kindly amend, lines 8 to 17, to read as follows:

Beneficially, all or a portion of the low-boiling fraction in substantially liquid form is diverted through conduit 32a and into an optional oxygenation process unit 110 for catalytic oxidation in the liquid phase with a gaseous source of dioxygen, such as air or oxygen enriched air. For the purpose of the present invention, the term "oxygenation" is defined as any means by which one or more atoms of oxygen is added to a hydrocarbon molecule. Particularly suitable catalytic oxygenation processes are disclosed in commonly assigned U.S. Patent Application Serial Number 09/779,285 [(37,248A)] and U.S. Patent Application Serial Number 09/779,283 [(37,248B)].

At page 26, kindly amend, lines 1 to 21, to read as follows:

From the bottom of column 70 a crude hydrotreated high-boiling liquid fraction is supplied to vessel 90 through conduit 78. Vessel 90 contains a bed of solid sorbent which exhibits the ability to retain acidic and/or other polar compounds, to obtain product containing less sulfur and/or less nitrogen than the feedstock to the hydrogenation [oxidation]. Product is transferred from vessel 90 to fuel blending facility 100 through conduit 92. Preferably, in this embodiment a system of two or more reactors containing solid sorbent, configured for parallel flow, is used to allow continuous operation while one bed of sorbent is regenerated or replaced.

In view of the features and advantages of processes in accordance with this invention [using selected organic peracids in a liquid phase reaction mixture maintained substantially free of catalytic active metals and/or active metal-containing compounds to preferentially oxidize compounds in which a sulfur atom is sterically hindered rather than aromatic hydrocarbons], as

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compared to known desulfurization systems previously used, the following examples are given. The following examples are illustrative and are not meant to be limiting. Unless otherwise indicated, percentages and ppm are on the bases of an appropriate
5 weight.

Version of Amended Claims with Markings
to Show Changes Made

1. (Once Amended) A process for the production of fuel
or blending component of fuels which are liquid at ambient conditions,
5 which process comprises:

providing a hydrotreated, petroleum distillate [high-boiling
hydrogenation] feedstock comprising a mixture of hydrocarbons and
sulfur-containing organic compounds, the feedstock consisting
essentially of material boiling between about 200° C. and about 425° C.
10 and having a sulfur content up to about 2,500 ppm;

contacting the [high-boiling] hydrotreated feedstock with a
gaseous source of dihydrogen at hydrogenation conditions in the
presence of a hydrogenation catalyst which exhibits a capability to
enhance the incorporation of hydrogen into one or more of the sulfur-
15 containing and/or nitrogen-containing organic compounds and under
conditions suitable for hydrogenation of one or more of the sulfur-
containing organic compounds; and

recovering a product comprising a mixture of hydrocarbons and
other organic compounds and having a sulfur content less than about
20 35 ppm of sulfur.

2. (Once Amended) The process for the production of
fuel or blending component of fuels according to claim 1 wherein the
hydrogenation [catalysts are the same or different and] catalyst
comprises at least one active metal, selected from the group consisting
25 of the *d*-transition elements, each incorporated onto an inert support
in an amount of from about 0.1 percent to about 20 percent by weight
of the total catalyst.

5. (Once Amended) A process for the production of refinery
transportation fuel or blending components for refinery transportation
30 fuel having a sulfur content less than about 15 ppm, which process
comprises:

hydrotreating a petroleum distillate consisting essentially of material boiling between about 50° C. and about 425° C. and having a sulfur content up to about 25,000 ppm, by a process which includes reacting the petroleum distillate with a source of hydrogen at
5 hydrogenation conditions in the presence of a hydrogenation catalyst to assist by hydrogenation removal of sulfur and/or nitrogen from the hydrotreated petroleum distillate, thereby producing a hydrotreated petroleum distillate having a sulfur content less than about 500 ppm;

fractionating the hydrotreated petroleum distillate by distillation
10 to provide at least one low-boiling blending component consisting of a sulfur-lean, mono-aromatic-rich fraction having a sulfur content less than about 15 ppm, and a high-boiling feedstock consisting of a sulfur-rich, mono-aromatic-lean fraction containing the balance of the sulfur;

contacting the high-boiling feedstock with a gaseous source of
15 dihydrogen at hydrogenation conditions in the presence of a hydrogenation catalyst which exhibits a capability to enhance the incorporation of hydrogen into one or more of the sulfur-containing and/or nitrogen-containing organic compounds and under conditions suitable for hydrogenation of one or more of the sulfur-containing
20 and/or nitrogen-containing organic compounds;

recovering a liquid comprising a mixture of hydrocarbons and other organic compounds, and having a sulfur and/or nitrogen content less than the high-boiling feedstock; [and]

treating at least a portion of the recovered liquid with a solid
25 sorbent for a time sufficient to reduce the sulfur content of the liquid phase and thereby [, an ion exchange resin, and/or a suitable immiscible liquid containing a solvent or a soluble basic chemical compound, to] obtain a product having a sulfur content less than about 15 ppm ;and

30 blending at least portions of the low-boiling blending component and the treated product to form fuel for use in internal combustion engines, which fuel exhibits a suitable flash point of at least 38° C. as measure by ASTM D93, and contains less than 15 ppm sulfur.

9. (Once Amended) A process for the producing a refinery transportation fuel or blending components for refinery transportation fuel having a sulfur content less than about 15 ppm, which process comprises:

- 5 providing a refinery distillate comprising a mixture of hydrocarbons, sulfur-containing and nitrogen-containing organic compounds, the mixture having a sulfur content up to about 25,000 ppm and consisting essentially of material boiling between about 200° C. and about 425° C.;
- 10 hydrotreating the refinery distillate with a source of hydrogen at hydrogenation conditions in the presence of a hydrogenation catalyst to assist by hydrogenation removal of sulfur and/or nitrogen from the hydrotreated distillate, to recover a hydrotreated distillate having a sulfur content less than about 500 ppm;
- 15 fractionating the hydrotreated distillate by distillation to provide at least one low-boiling blending component consisting of a sulfur-lean, mono-aromatic-rich fraction having a sulfur content less than about 15 ppm, and a high-boiling feedstock consisting of a sulfur-rich, mono-aromatic-lean fraction containing the balance of the sulfur;
- 20 contacting the high-boiling feedstock with a gaseous source of dihydrogen at hydrogenation conditions in the presence of a hydrogenation catalyst which exhibits a capability to enhance the incorporation of hydrogen into one or more of the sulfur-containing organic compounds and under conditions suitable for hydrogenation of
- 25 one or more of the sulfur-containing organic compounds; [and]
recovering a [high-boiling liquid having a sulfur content less than about 15 ppm.] liquid comprising a mixture of hydrocarbons and other organic compounds, and having a sulfur and/or nitrogen content less than the high-boiling feedstock; [and]
- 30 treating at least a portion of the recovered liquid with a solid sorbent an ion exchange resin, and/or a suitable immiscible liquid containing a solvent or a soluble basic chemical compound for a time sufficient to reduce the sulfur content of the liquid phase and obtain a product having a sulfur content less than about 10 ppm : and

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blending at least portions of the low-boiling blending component and the treated product to form fuel for use in internal combustion engines, which fuel exhibits a suitable flash point of at least 38° C. as measure by ASTM D93, and contains less than 15 ppm sulfur.

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